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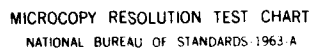
MICROCOPY RESOLUTION TEST CHART

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MEMORANDUM REPORT ARBRL-MR-03365

A GEOMETRIC DATABASE RETRIEVAL SYSTEM
FOR SPARC

Joan H. Walter

August 1984

US ARMY ARMAMENT RESEARCH AND DEVELOPMENT CENTER
BALLISTIC RESEARCH LABORATORY
ABERDEEN PROVING GROUND, MARYLAND

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Characteristics of selected components of fielded US weapons systems can be retrieved with an interactive computer program. The component data includes national stock number, stockage and provisioning codes, replacement time, and damage criteria. A geometric representation of the component may be viewed interactively from any aspect (azimuth, elevation). The presented area of the component may be calculated interactively from any aspect. Components may be retrieved by specifying national stock number or name. A table of components and their characteristics is provided when a query returns more than one

component. The data was compiled from SPARC (Sustainability Predictions for
Army spare components Required for Combat) studies. The INGRES database sys-
tem is used to store and retrieve the component data. The user interface
program formats the database queries from user commands; no database experience
is necessary to use the program.

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I. INTRODUCTION

Sustainability Predictions for Army spare components Requirements for Combat, or SPARC, is a high priority program developed at the direction of the Department of the Army. The program's objective is to enhance the sustainability of critical Army systems in combat by:

- Predicting parts which may be damaged

- Product improving those parts

- Developing field repair procedures

The US Army Ballistic Research Laboratory (BRL) has been a major participant in the SPARC program providing SPARC analyses which are highly detailed vulnerability assessments to predict parts which will be damaged in combat. Such analyses provide those indicators required to assemble the combat Prescribed Load List (PLL) and Authorized Stockage List (ASL) requirements, Manpower Authorization Criteria (MACRIT), and determine general support costs. Such analyses provide the quantitative basis upon which provisioning of spare parts for combat and various ancillary studies can be based.

Large amounts of data have been generated as a result of various SPARC analyses. These data include compilations of descriptive information needed to perform the detailed analyses. The best way to store and retrieve these data is with a computerized data base management system. The INGRES[1] data base management system was chosen. It runs under the Ballistic Research Laboratory's UNIX* operating system on a DEC PDP 11/70 minicomputer.

A user interface program was written to help the analyst retrieve information. The program retrieves graphical and descriptive information and writes formatted data files. No database background is required by the analyst. This report will describe the use of the interface program.

A. Background

A three dimensional representation of the military target is required to perform a SPARC vulnerability analysis. The target description is built by representing parts of the target system using standard geometric solids, which are combined by boolean operations to approximate the physical geometry of the part. The GIFT[2] report describes the construction of a three-dimensional target description.

---

[1]G.D. Held, M. Stonebraker, and E. Wong, "INGRES - A Relational Data Base Management System," Proc. 1975 National Computer Conference, AFIPS Press, 1975.

*Unix is a trademark of Bell Laboratories

[2]Lawrence W. Bain and Mathew J. Reisinger, "The GIFT Code User Manual; Vol I, Introduction and Input Requirements," BRL Report No. 1802, July 1975 (AD# B0060371L)

A SPARC vulnerability analysis is performed with respect to the mission(s) the target must execute on the battlefield. Thus, each component that contributes to the performance of the target's mission(s), that is each mission essential component (MEC), must be included in the target description. The following information is required for each MEC:

- National stock number

- Source, maintenance,and recoverability (SMR) code

- Replacement time

- Damage criteria for replacement.

The data records for the mission essential components are compiled from technical manuals by the SPARC analysts and contain the national stock number, the functional group, the source, maintenance and recoverability code (SMR code), the component name, the quantity, and the technical manual reference. Each component also has a replacement time obtained from a Mission Allocation Chart (MAC), a damage criteria, and a three-dimensional representation.

The SPARC database was designed to include as much of the collected data as would be useful for further studies. Perhaps the most functionally useful aspect of the preserved data is the geometric information of the components which permits the analyst to view any component on a graphics computer terminal. The SPARC geometry data is available for each mission essential component. The analyst can view the solids which comprise the component and can produce formatted files of the geometric description of the component.

B. Objective

The database has been developed to assist vulnerability analysts in developing the target inputs required for a SPARC analysis: the target description and the inputs characterizing the individual components for the SPARC vulnerability model. The user interface program was written to retrieve information, provide arbitrary views of the geometry, and interactively calculate the presented area of the component for any view.

II. DATA RETRIEVAL

The data records for the mission essential components are compiled from the system technical manuals by the SPARC analysts. This section describes retrieval of this data from the SPARC database using the user interface program. Table 1 shows a typical component record.

Table 1. SAMPLE SPARC RECORD

Field	Sample Data
target name	M88A1
national stock number	2590-00-083-0266
functional group number	2963
name	aux pwr unit relay
source, maintenance, and recoverability code	paffz
identification number	4319
quantity	1
lump	
assembly	T
detail	
weighting percentage	00
weight adder	1
technical manual reference	1
replacement time	1.0
probability of damage code	04

The user program was written to prompt analysts for their commands and to automatically format those commands as database queries. The program was written so that analysts would not need to learn a database query language and so that the graphics programs could be integrated with the retrieval procedures. The program prints a menu, as shown in Figure 1, and prompts the analysts for a command.

SPARC DATA BASE

Options:

LIMITS
(set some restrictions on your search)

name	search by component name
ident	search by component geometry identification number
group	search by functional group number
stock	search by component stock number
target	limit to specified targets
	the default is the entire database
	a list of targets will be printed

COMMANDS

print	print (search and print component records)
view	view component(s) with program VIEW
deck	produce geometry deck with program DECK formatted for GIFT input

please enter option(? for list of options, option, or quit):

Figure 1. The Driver Program Menu

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The analyst must select a component by providing some information about the component, such as its name or national stock number. As soon as some information about a component has been provided, the analyst can use the command, "print," to print all those components matching the input parameters. The selection of a component by specifying some parameters is referred to as "limiting the search." Without limits, a "print" command will print every component in the database.

Figure 2 shows the user entering "name" to select the option to search by component name. The program responds with the prompt, "enter name:." The user then enters the name, "cylinder head." The program reads the name, stores it, and returns the user to the main menu. The user could specify other parameters, such as target or group. Figure 2 then shows the user entering a "print" command to search the database and print the components. The user's input to the program is shown underlined. The program responds with "searching database," followed by the data headings and the components which matched the query.

```
please enter option(? for list of options, option, or quit): name
enter name: cylinder head
please enter option(? for list of options, option, or quit): print
searching database
```

Target	Nat'l Stock No.	Component	SMR	Group	Ident	P/D
M88A1	2815-00-150-7405	cylinder head	pahhd	0101	718	04
M561	2815-00-789-1006	cylinder head	pahzz	0101	402	05

```
please enter option(? for list of options, option, or quit):
```

Figure 2. Data Retrieval: Name Search

After the search, the program is ready to accept any command on the original menu. When a limiting command is given to specify component characteristics, the program prompts for the characteristics and then returns to the original menu.

The ident number, the group number, and the national stock number may be selected in the same way as the component name. The ident number "372" is entered. This ident number references the three dimensional representation of the component.

```
please enter option(? for list, q to quit): ident
enter ident number: 372

please enter option(? for list, q to quit): print
searching database
```

Target	Nat'l Stock No.	Component	SMR	Group	Ident	P/D
M561	4720-00-404-7443	air hose carrier	paozz	1208	372	39

Figure 3. Data Retrieval: An Ident Number Search

Figure 4 shows a group number search. The group number is the functional group number shown in the system technical manual.

```
please enter option(? for list, q to quit): group
enter group number: 1601

please enter option(? for list, q to quit):print
searching database
```

Target	Nat'l Stock No.	Component	SMR	Group	Ident	P/D
M561	5360-00-081-5428	susp spring frt	paozz	1601	573	05
M561	5360-00-081-5428	susp spring rear	paozz	1601	581	05

Figure 4. Data Retrieval: Group Search

Figure 5 shows national stock number searches. A range of stock numbers can be allowed in a search by using an asterisk to replace part of the stock number, as shown in Figure 5.

```
please enter option(? for list, q to quit): stock
enter stock number( or nnn* for part of number): 6830-00-292*

please enter option(? for list, q to quit): print
searching database
```

Target	Nat'l Stock No.	Component	SMR	Group	Ident	P/D
M88A1	6830-00-292-0129	cylinder,oxygen		9999	384	27
M88A1	6830-00-292-0137	cylinder,acetyl		9999	2012	03

```
please enter option(? for list, q to quit): stock
enter stock number( or nnn* for part of number): 6830-00-292-0129

please enter option(? for list, q to quit): print
searching database
```

Target	Nat'l Stock No.	Component	SMR	Group	Ident	P/D
M88A1	6830-00-292-0129	cylinder,oxygen		9999	384	27

Figure 5. Data Retrieval: National Stock Number Search

Several items of information may be provided to be sure of identifying a single component. For example, the analyst can specify the component name and a functional group number. Figure 6 shows the analyst retrieving components with the name "housing" and the functional group 1301, which is track and wheel suspension.

```
please enter option(? for list, q to quit):name
enter name:housing

please enter option(? for list, q to quit):group
enter group number:1301

please enter option(? for list, q to quit):print
 searching database
```

Target	Nat'l Stock No.	Component	SMR	Group	Ident	P/D
M88A1	2530-00-832-5258	housing,track susp	paooo	1301	1009	56
M88A1	2530-00-832-5258	housing,trk/front	paooo	1301	1048	56

Figure 6. Data Retrieval: Name and Group Search

The data base contains information from several targets. By default, all targets will be included in the search. For information about the targets, type "target." As in Figure 7, the program will list the available targets and prompt for input. The user enters a dash followed by the target name as it appears in the original list to subtract any target. The program will list the current targets, showing the update.


```
please enter option(? for list of options, option, or quit):target

            targets relation


            target        analyst        date

            M88A1         Saccenti       Mar 82
            M125A1        Crisco         Mar 82
            M561          Vanderbeek     Dec 82


enter target to add or -target to subtract
(enter target system name or enter "all"):
```

Figure 7. Target Information and Prompting

The probability of damage to the component is listed as a number with the heading "p/d." which refers to a probability of damage criterion established by the analyst(s) for the study. Numbers from 1 to 54 refer to a standard library of damage criteria developed for all SPARC studies. Numbers greater than 54 indicate that user-defined step functions were used in the study.

The restrictions which the analyst places on the search are cumulative. Once the name has been specified, for example, all further queries will search for that name until it has been changed. To remove the name restriction, select "name" and answer the prompt with a single asterisk, "*." Use the same method for national stock number, functional group, or ident.

III. DRAWING THE COMPONENT

Once the analyst has printed the component information, he can draw the component on his terminal screen by typing "view." The view command starts the VIEW program which will prompt for input. The VIEW program has a menu of options (Table 2) for drawing the object of interest. This menu can be printed interactively by entering a "?." The program automatically issues directions for keeping files which contain the drawings.

Table 2 shows all the VIEW commands. Brackets indicate information which the user provides and will be explained for each command.

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Table 2. THE VIEW PROGRAM MENU

Commands	Description
area [-t tolerance]	Display presented area of selected plot.
AREA [-t tolerance]	Display presented area and plot bounds.
Batch	Batch input/output mode.
clear screen	Erase the screen except for graphics.
delete [object...]	Remove objects from current list.
erase	Erase current list (same as 'remove' *).
grid	Draw grid to show scale of plot.
insert [object...]	Add an object to current list.
list [object...]	Display current list of objects.
megatek [plotfilename]	Send plot to Megatek (only from brl-vld).
Megatek [plotfilename]	Send evaluated region plot to Megatek.
newform	Erase graphics.
plot [plotfilename]	Plot list of objects.
Plot [plotfilename]	Plot objects with evaluated regions.
quit	Terminate program.
rotate [azim.] [elev.]	Select viewing angle.
Screen	Interactive input/output mode.
sort	Sort the table of contents.
toc [object...]	Table of contents.
versatec [plot file]	Send plot to Versatec (only from brl-bmd).
Versatec [plot file]	Send evaluated region plot to Versatec.
! [shell command]	Execute a UNIX shell command.

The first command which is always required is "insert g*," which will place the component in the list of objects to plot. The geometry file contains solids, regions and groups. Any of these can be specified where the menu shows "[object...]." For the geometry files in the database, there will always be one object which starts with a "g" (which stands for group). This group represents the component. There will be one or more objects whose names begin with "s." These are the primitive solids. There will be one or more objects whose names begin with "r." These are the regions, which are solids combined with boolean operations. The analyst can select certain solids or regions to plot which are part of the component.

The next command, "plot," will initiate the drawing. If the analyst enters "plot filename," graphics information will be saved in the file "filename." The object will be drawn from the front view (azimuth = 0 and elevation = 0).

For other views, the "rotate" command is used and the program will prompt for the azimuth and elevation. Figure 8 shows the track and road wheels from the M125A1 viewed from four views.

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a) front view (0,0)   b) top view (0,90)

c) side view (90,0)   d) oblique view (25,35)
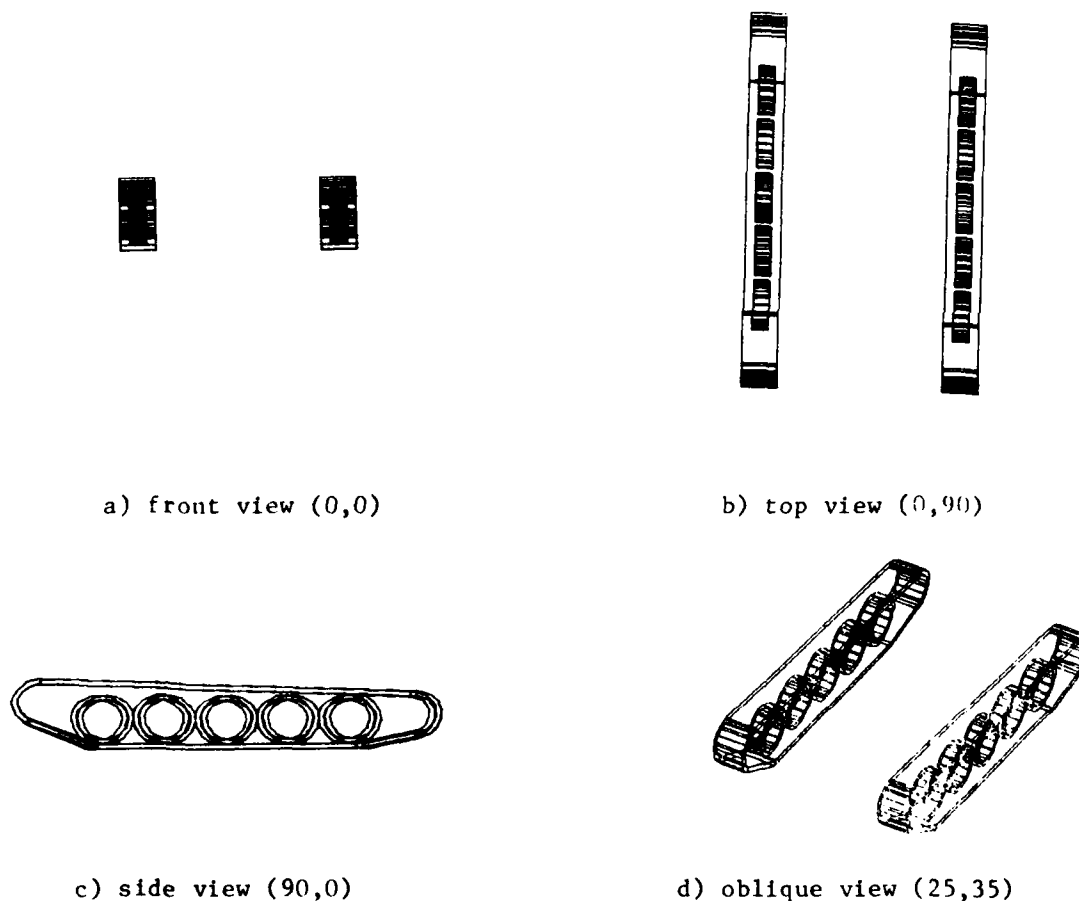
Figure 8.   VIEW: Views of M125A1 Road Wheels
(Azimuth, Elevation)

After drawing the component, more drawings may be made or the analyst may return to the main menu by typing "quit."

The "plot" command initiates the drawing of the component on the screen. All primitive solids are drawn. The "PLOT" command evaluates the component by regions and draws each region with subtracted solids removed from the drawing. The evaluator does not currently handle regions containing the arbitrary solid (ARS) and Torus solid.

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Figure 9 shows a component from the view azimuth = 90, elevation = 0. The drawing on the left was produced by the "plot" command; the one on the right was from the "PLOT" command.
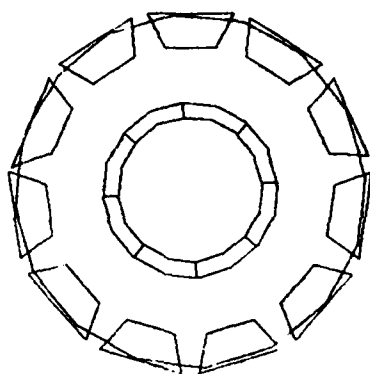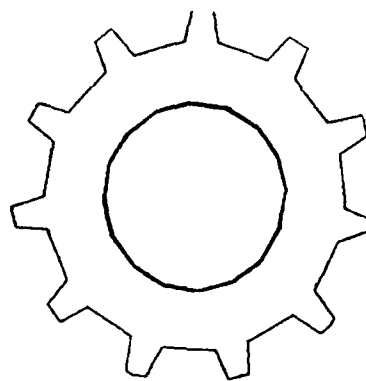
"plot" drawing   "PLOT" drawing

Figure 9. VIEW: A Comparison of the Commands plot and PLOT

The presented area of a component can be calculated using the "area" command. The algorithm is fast, which permits interactive calculations for any view. For most accurate results, the command "Area -t .005" is used, which uses .005 inches as a tolerance for line intersections and shows the boundary for the presented area. Figure 10 shows the boundary of a transmission, as seen from a side view. The presented area is calculated to be 264.70 square inches. All the geometric descriptions in the database are in inches. Future descriptions may be in millimeters.

Figure 10. The Boundary of a Transmission Using the Area Command

If the component is comprised of disjoint regions, the area can be calculated for only one of those regions. The road wheels, for example, will be disjoint from some orientations.

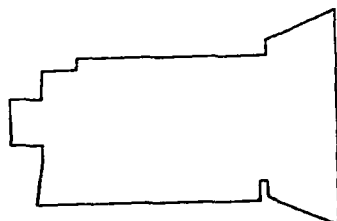The VIEW program will produce plots on various graphics terminals using the Terminal Independent Graphics package (TIG). The VIEW program will also divert plots to other plotting devices available on the computer system. For the SPARC database, the "versatec" and "Versatec" commands will divert the plot file to a versatec plotter.

IV. PRODUCING A GEOMETRY FILE

The geometry information is available as a Graphics Editor (GED)[3] file or as GIFT input. The command "deck" is used to enter a specialized menu for deck preparation. Table 3 shows the menu for preparing a geometry file for GIFT input.

Table 3. THE MENU FOR GEOMETRY FORMATTING PROGRAM

COMMAND	DESCRIPTION
deck [output file prefix]	Produce GIFT input file.
erase	Erase current list of objects.
insert [object[s]]	Add an object to current list.
list [objects[s]]	Display current list of selected objects.
number [solid] [region]	Specify starting numbers for objects.
quit	Terminate run.
remove [object[s]]	Remove an object from current list.
sort	Sort table of contents alphabetically.
toc [object[s]]	Table of contents of solids database.
! [shell command]	Execute a UNIX shell command.

NOTE: First letter of command is sufficient, and all arguments are optional. Objects may be specified with string matching operators (*, [ ], -, ? or) as in the UNIX shell.

The command "insert g*" is always used to initialize the program to include the component. The command "deck filename" produces the deck with the name "filename."

The GED format data is stored under the main UNIX system directory /vld/sparcdb. Each component is stored in a separate file under a subdirectory of the target system name. The filename is formed from appending ".g" to

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[3]Michael J. Muuss, Keith A. Applin, J. Robert Suckling, Gary S. Moss, Earl P. Weaver, and Charles A. Stanley,"GED: An Interactive Solid Modeling System for Vulnerability Assessments," BRL Report ARBRL-TR-02480, March 1983.

the identification code for the component. For example, the oil pan for the M561 light recovery vehicle has an identification code of 410. The file for that component is "/vld/sparcdb/M561/410.g." This file can be copied to the user's file directory with the ordinary UNIX copy command "cp." The analyst can use the GED format data directly for new target descriptions.

V. CONCLUSION

Many components of US weapons systems have been analysed for SPARC studies. Component data includes geometric descriptions, national stock numbers, stockage codes, and damage criteria. This data has been stored in a database using INGRES as a database manager. A user interface program retrieves tables of component characteristics, provides graphical display of the component, and calculates the presented area for any view (azimuth, elevation). The SPARC analyst can use this data when studying new military systems to save time in preparing geometric descriptions and to achieve greater analytic consistency between similar systems.

ACKNOWLEDGEMENTS

APPENDIX A

Using the SPARC Database on the Computer System

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Using the SPARC Database on the Computer System

The SPARC data base and the interactive retrieval program are available on a PDP11/70 located at Aberdeen Proving Ground, Aberdeen, Maryland. A new user needs login permission for the "brl-bmd" minicomputer and further permission to access the INGRES database. These permissions can be granted to qualified users upon request.

The PDP11/70 uses the UNIX operating system. Figure A-1 is an example of a user sign-on. User responses are underlined.

```
JHU/UNIX 6.218     Ballistic Modeling Division  ttya
11/70 1024kw mem, 72/125 procs, 24 users.    Unattended

User Name: joanw
Password:
08/22083 13:28:14   Joan Walter (VLD/VMB)   <joanw@vld70>
Prev: 08/19 16:27   from ttya
enter terminal type> vt100
TERM=vt100
$
```

Figure A-1. Sign-on Procedure for UNIX Operating System

The new user must establish a file name ".profile" which the operating system will read and execute for each login. The ".profile" file contains the information about file searching and terminal identification necessary to run the driver program. The ".profile" file should contain the following lines:

```
PATH=:/bin:/usr/bin:/usr/ofcbin:/usr/vldbin:/vld/sparcdb
export HOME PATH TERM
case $TERM in
telnet | dialup) /usr/7bin/echo -n "enter terminal type>"
    read TERM junk; echo TERM=$TERM
    export TERM;;
esac
```

PATH and TERM are variables; PATH gives the search order for file systems, while TERM sets a name for the user's terminal type.

The terminal type must be set for the graphics options. The following terminals are supported:

terminal	designation
Hewlett Packard 2648	hp2648
Hewlett Packard 2647	hp2647
Hewlett Packard 2645	hp2645
Hewlett Packard 2641	hp2641
Megatek	Megatek
Ramtek	Ramtek
Tektronix 4016	tk4016
Tektronix 4014	tk4014
Tektronix 4025	tk4025a
Retrographics VT100	vt100
Vector General	Vector General

Many other terminals will emulate one of the types listed.

The data base retrieval program will run from an alphanumeric terminal, but graphical options (such as plot and area) require graphical devices. The sign-off procedure is shown in Figure A-2.

```
quit
$logout
Checking... OK (Infinite)
Disk reads        437      writes                87
Connected     0:02:31     to date      17:37:59
CPU time      0:00:09.18  to date      1:01:34.73
ttya free Mon Aug 22 13:30:45 1983
```

Figure A-2. Sign-off Procedure for UNIX Operating System

APPENDIX B

Sample Retrieval for Component Characterization

APPENDIX B

Sample Retrieval for Component Characterization

This appendix shows a sample retrieval of SPARC component characterizations. The figures show an interactive computer terminal session.

The terminal session is divided into sections and the text typed by the analyst is underlined. The pictures drawn of the components have been scaled down from full page size.

The retrieval program performs four functions: selection of characteristics of a component, retrieval of all components which match the characteristics, geometric data display, and geometric data formatting. The selection of the component characteristics must be performed first; otherwise, the print command would result in the printing of all components in the database.

Figure B-1 shows the instructions for the analyst. The analyst must type commands to tell the program what to retrieve. Note that all input commands are terminated with a keyboard carriage return. The dollar sign, which appears in the first and last examples, is the UNIX operating system prompt character.

$/vld/sparcdb/dbl
 SPARC database
Options:

LIMITS
(set some restrictions on your search)

name   search by component name
ident   search by component Com Geom ident
group   search by functional group number
stock   search by component stock number
target   limit to specified target vehicles
         the default is the entire data base
         a list of targets will be printed

COMMANDS
print   print (search, and print component records)
view   view component(s) with program VIEW
deck   produce comgeom decks with program DECK

Figure B-1. Retrieval Sample: Command Menu

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The database retrieval would typically begin with the component name. Analysts select mission essential components from a technical manual, which provides a standard name. As an example, take the case in which the analyst identifies a component, "PERISCOPE,M17," quantity 3, national stock number 6650-00-704-3549. Figure B-2 shows a retrieval from its start with the execution of the driver program through the list of the components retrieved using the "name" retrieval on "periscope."

```
enter option(? for list, q to quit): name
enter name: periscope
enter option(? for list, q to quit): print
```

Target	Nat'l Stock Number	Component	SMR	Group	Ident	P/D
M88A1	1240-00-344-4667	periscope,m24 w/box		9999	2024	04
M88A1	6650-00-704-3549	periscope,m17(t24)		9999	3100	43
M88A1	6650-00-704-3549	periscope,m17(t24)		9999	3101	43
M125A1	2540-00-513-9934	guard periscope	paozz		3441	60
M125A1	2590-00-019-3965	plug assb periscope	paooo		3441	60
M125A1	2590-00-590-0241	mount periscope	paooo		3441	60
M125A1	2590-00-898-6771	cover assb periscope	paozz		1041	60
M125A1	5330-00-135-6567	seal periscope guard	paozz		3441	60
M125A1	6650-00-704-2971	periscope,m19	paozz		345	43
M125A1	6650-00-704-3549	periscope,m17	paozz		343	43
M125A1	6650-00-704-3549	periscope,m17	paozz		344	43

Figure B-2. Retrieval Sample: "name" Search For "periscope"

In Figure B-2, the driver program has printed all components which have the word "periscope" within their name, including some mounting hardware. The m17 periscope, stock number 6650-00-704-3549, has already been described and recorded for both the M125A1 and the M88A1.

The "view" command will produce plots of the component, as shown in Figure B-3. The component which will be plotted is the last one which was printed, unless otherwise specified.

view
VIEW 2.13 (? for help) /vld/sparcdb/M125A1/344.g
Ready.
insert g*
Ready.
plot
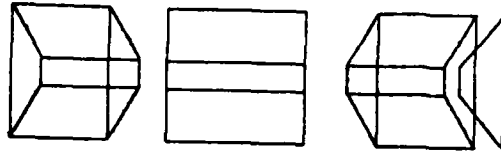
Rotation 0.00   0.00

a) (0,0)

Ready.
newform.
Ready.
rotate 25 35
Ready.
plot
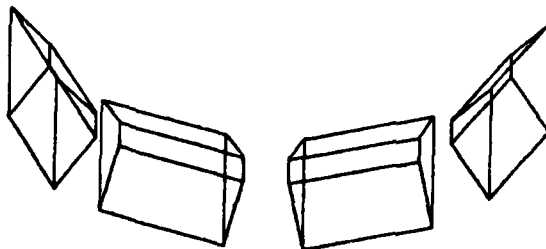
Rotation 25.00   35.00

Ready.
newform
Ready.
quit

Figure B-3. Graphical Sample: Requesting a Plot With
(Azimuth, Elevation) Aspect Angle

The "view" command takes the user to a graphics program to display the
component. The header line "VIEW 2.13" identifies the version and level of
the view program. A "?" can be typed by the analyst and the program will type

a table of commands and descriptions to help run the program. The first command to use is "insert g*" to insert appropriate graphic elements. The command "plot" executes the plotting routine. The plot is labelled with "Rotation 0.00 0.00" to show the viewing aspect. This is shown in the upper half of Figure B-3.

After the plot, the view program prints "Ready" on the screen. Before proceeding with another plot, the analyst types "newform" to clear the screen. The command "rotate 25 35" is shown; this sets the viewing aspect angles at 25 degrees azimuth and 35 degrees elevation. The analyst may select any viewing angles. The command "plot" initiates the drawing. The drawing from the view is shown in the lower half of Figure B-3.

The analyst types "newform" to clear the screen and "quit" to leave the View program. The View program types "Bye." The driver program continues with a prompt for a command "enter option:."

Proceed to impose another limit on the search to view other components. For example, examine "ident" 343. Figure B-4 shows the "ident" command followed by the program prompting for the ident number. Enter "print," and only the listing for 343 is printed. The "view" command will then plot the component with identification code 343.

```
enter option(? for list, q to quit): ident
enter ident: 343
enter option(? for list, q to quit): print
  searching database
```

Target	Nat'l Stock No.	Component	SMR	Group	Ident	P/D
M125A1	6650-00-704-3549	periscope,m17	paozz		343	43

Figure B-4. Retrieval Sample: "ident" and "name" Search

```
enter option(? for list, q to quit): view
VIEW 2.13(? for help)      /vld/sparcdb/M125A1/343.g
Objects tallied: 11
Ready.
insert g*
Ready.
rotate 25 35
Ready.
plot
```
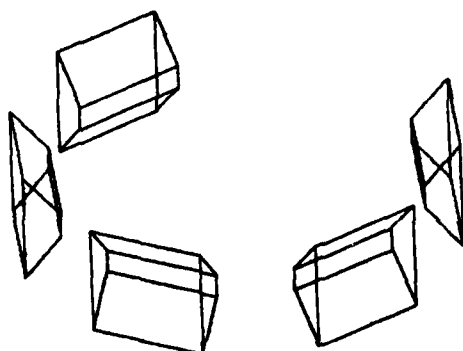

Rotation   25.00   35.00

```
newform
Ready.
quit

Bye.
```

Figure B-5. Geometry Display: Request by Component Ident Number

Note that the objects are similar for ident 343 and ident 344 but that ident 343 shows more objects. The item "periscope,ml7" appears as a quantity of five for ident 343 and a quantity of four for ident 344. Each item is a prism; the gunner's sight may use the same prisms as the commander's sight but in a different configuration and quantity.

The limit "ident=343" was set in addition to the limit "name=periscope." Both limits are now set for this retrieval. The analyst must reset these limits to proceed to another search.

Another component search will be shown to illustrate more of the commands. A different component is shown for the next retrievals. Both the "name" limit and the "ident" limit will be reset.

The component name "wheel" is used for the next retrieval. Figure B-6 shows the commands. The program prints the previous component name as an aid to the analyst. In this example, the previous component name used was "periscope," which was shown in Figure B-2. The program prints this as "*periscope*." The asterisks are a universal string matching feature available within the database so that names do not have to be an exact match. The interface program inserts these asterisks. It is possible to look for an exact name by typing the name with double quotes enclosing it. The interface program will create the data base query using just the name.

The ident field is still set for 343. This is reset by selecting the ident option and specifying an asterisk. The asterisk is the universal string matching character and will not limit the search.

The last component printed, "air tube wheel r frt," is viewed by default. The analyst selects the "wheel center left" instead by setting its ident number 529 as a limit and printing the new retrieval. The print command must always be used after resetting a limit before a new view is requested. This ensures that the component requested exists or permits the program to send a message that none exists.

```
please enter option(? for list, q to quit): name
previous component name:  *periscope*
enter name: wheel
please enter option(? for list, q to quit): ident
previous ident number: 343
enter ident number: *
please enter option(? for list, q to quit): print
 searching database
```

Target	Nat'l Stock No.	Component	SMR	Group	Ident	P/D
M88A1	2530-00-701-3976	wheel,solid,rubber	pcodd	1301	1000	56
M88A1	2815-01-011-2665	flywheel adapter	pbfzz	0103	700	06
M88A1	2815-01-024-9293	engine flywheel	pbfzz	0103	700	06
M88A1	3020-00-614-7609	sprocket,wheel	pafzz	2919	7735	59
M88A1	3020-00-614-7734	gen/sprocket wheel	pafzz	2919	7736	29
M125A1	1015-00-868-8026	handwheel	pafff		4087	03
M125A1	2520-00-678-8382	wheel sprocket; fin	paozz		621	60
M125A1	2520-00-678-8382	wheel sprocket; fin	paozz		622	61
M125A1	2520-00-678-8382	wheel sprocket; fin	paozz		620	60
M125A1	2530-00-334-5877	wheel solid rubber	paodl		630	42
M125A1	2530-00-715-3862	hub ass rd wheel sup	paooo		666	60
M125A1	2530-00-856-2299	wheel metal tire; id	paozz		624	30
M125A1	2530-01-034-1147	hub ass rd wheel sup	paooo		666	60
M125A1	2815-00-074-1938	flywheel engine	pafhh		708	06
M125A1	2815-01-037-5250	housing flywheel	pfddd		707	30
M125A1	3020-00-141-1154	sprocket wheel	paozz		621	60
M125A1	3020-00-141-1154	sprocket wheel	paozz		622	61
M125A1	3020-00-141-1154	sprocket wheel	paozz		620	60
M125A1	1015-00-342-1098	handwheel traversing	pafzz		4073	03
M125A1	1015-00-868-8026	handwheel	pafff		4088	03
M561	2530-00-080-6572	steering wheel	paozz	1401	700	04
M561	2530-00-245-1169	wheel center left	paozz	1313	529	03
M561	2530-00-245-1169	wheel center right	paozz	1313	530	03
M561	2530-00-245-1169	wheel front left	paozz	1313	508	03
M561	2530-00-245-1169	wheel front right	paozz	1313	504	03
M561	2530-00-245-1169	wheel rear left	paozz	1313	535	03
M561	2530-00-245-1169	wheel rear right	paozz	1313	536	03
M561	2815-00-080-6531	engine flywheel	pafzz	0103	415	04
M561	4710-00-051-3281	air tube wheel r frt	pafzz	1208	356	01

```
please enter option(? for list, q to quit): ident
enter ident number: 529
please enter option(? for list, q to quit): print
 searching data base
```

Target	Nat'l Stock No.	Component	SMR	Group	Ident	P/D
M561	2530-00-245-	1 wheel center left	paozz	1313	529	03

Figure B-6. Retrieval Sample: "name" Retrieval for "wheel"

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The drawing for the wheel is shown in Figure B-7. The first drawing includes all primitive solids. The second drawing shows the evaluated component, with primitive solids subtracted. The third drawing shows the wheel from another aspect angle and clearly shows the empty center space.

```
please enter option(? for list, q to quit): view
VIEW 2.13 (? for help)     /vld/sparcdb/M561/529.g
Objects tallied 4.
```

```
Ready.                                    Ready.
insert g*                                 PLOT
Ready.
plot
```
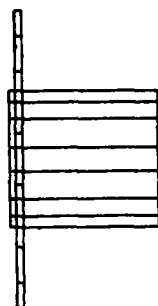
a) "plot"   b) "PLOT"

```
Ready.
rotate 25 35
Ready.
PLOT
```

```
Ready.
quit
Bye.
```
          c) "PLOT"

Figure B-7. Retrieval Sample: "plot" and "PLOT"

The VIEW program also permits selection of any combination of primitive solids to plot.

Figure B-8 shows the wheel from the aspect (90,0) with a grid superimposed to indicate the scale of the component.
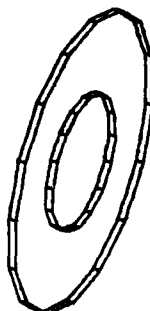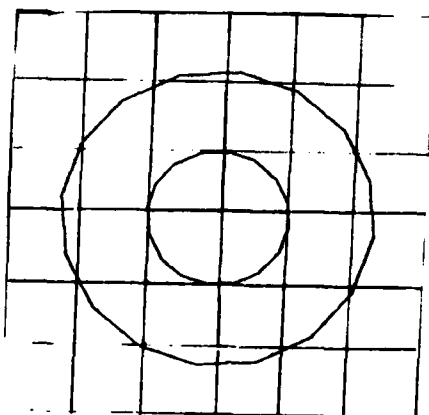
Ready.
rotate 90 0
Ready.
grid

Grid cell size 5.0 units.
Figure B-8.   Graphical Sample: "grid" Command

An option is available for an interactive calculation of the component's presented areas. This calculation uses the boundary lines of the component to estimate the enclosed area. This has some limitations. The calculation for a component which has more than one enclosed area, such as the periscope which had four prisms, will be valid for just one of the enclosed areas. A component with a hole, like the wheel, will have a presented area which includes the hole. In most cases, the analyst can estimate the true area by calculating areas for the primitives individually and combining these areas as appropriate. The VIEW program draws an outline of the component for the AREA option. This outline is especially useful for the special cases where the analyst must identify what part of the component's area was included in the calculation.

Figure B-9 shows the AREA command to calculate the presented area of the wheel from the aspect (90,0). The AREA command requires the analyst to supply a parameter, the tolerance, or line accuracy, with the form "AREA -t .005." Figure B-9 also shows the areas of the primitive solids from that aspect.

33

newform
Ready.
AREA -t .005
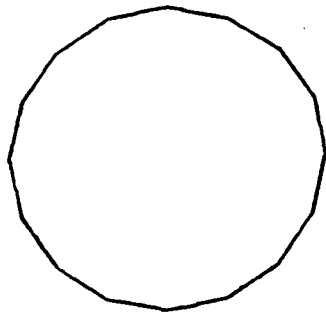
Presented Area = 370.436

a) "AREA"

newform
toc
s166 s168 r157 g5
delete *
insert s168
AREA -t .005

Presented Area = 370.435

b) Presented Area: Primitive Solid

Ready.
Delete s168
Ready.
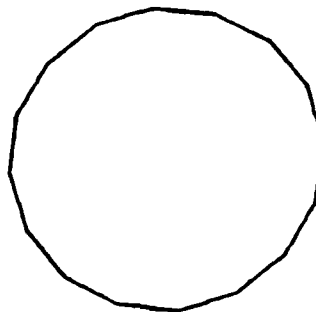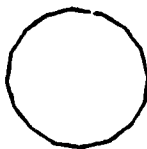insert s166
Ready.
Area -t .005

Presented Area = 76.5369

c) Presented Area: Primitive Solid

Figure B-9. Presented Area Calculations

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The VIEW program prints the name of the geometry file on each plot. The wheel geometry file is named "/vld/sparcdb/M561/529.g." This file can be used directly with the graphics editor (GED).

The DECK program converts the geometry file to a Com-Geom format file. The program can be used directly or called with the option "deck" from the retrieval program. Figure B-10 shows the deck program used from the retrieval program. The figure also shows the files produced, using the UNIX command "type" to list the files.

```
        Ready.
        quit
        Bye.

        enter option(? for help, q to quit): deck
        4 objects tallied
        Command ( ? for menu)>>insert g*
        deck




        REGION      1      /g5/r157
        O U T P U T    F I L E S :

        solid table = "solids"
        region table = "regions"
  region identification table = "region_ids"

        command( ? for menu )>> quitting...

        enter option(? for help, q to quit): quit
        $type solids
        /vld/sparcdb/M561/529.g
```

		2	1			
1rcc	119.6680	41.5000	18.0000	.0000	-.5000	.0000s168
1	11.0000	.0000	.0000			s168
2rcc	119.6680	42.0000	18.0000	.0000	-11.0000	.0000s166
2	5.0000	.0000	.0000			s166

```
$type regions
   1    1    -2                                            r157
$type region ids
  -1
        0
        1      529        0          g5/r157
```

Figure B-10. Deck Program Sample

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